Backyard Explorer

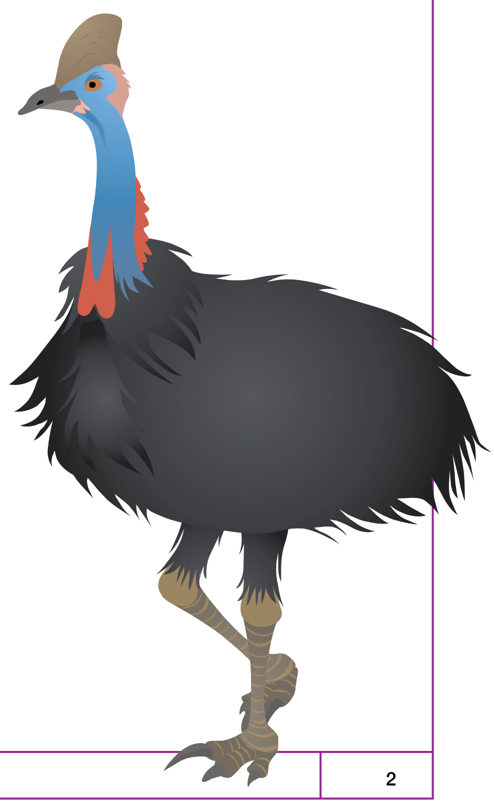
A Guide to Biodiversity Assessments for Schools and Communities

Leader's Guide

QUEENSLAND MUSEUM NETWORK

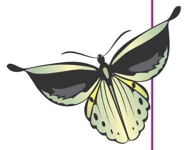
Queensland Government

Contents



Introduction

Backyard Explorer helps students and community to appreciate the biodiversity of their schoolyards, backyards and study areas even though they may be modified, urban habitats.



It creates a relevant, locally-focused context to teach ecology using field work activities suitable for middle school students and community groups. Some activities suitable for Years 8–9 are marked **. By trapping and making observations, they can determine the number and variety of invertebrates, reptiles and birds in natural, or more disturbed, local areas. The methods of *Backyard Explorer* are used by scientists at the Queensland Museum to audit biodiversity; see the *Terrestrial Invertebrate Status Review* for Brisbane City available at: <http://www.qm.qld.gov.au/Learning+Resources/Resources>

High levels of animal and plant biodiversity indicate healthier ecosystems. A comparison study with a more disturbed area, or with data collected in other areas by other schools or community groups, would improve understanding of factors that affect biodiversity.

The activities in *Backyard Explorer* should be supplemented with textbook and other resources. Technical terms should be used when required such as predators, competitors, food chains and webs and ecosystems.

Literacy focuses

- tables
- habitat profile
- numbers pyramid
- wildlife photos
- storyboards
- digital story

Using the interactive key

The Key to Invertebrates is available on the CSIRO website: http://www.ento.csiro.au/education/key/couplet_01.html

Making digital stories

Digital stories are mini-documentaries. They are a good way for students and community to demonstrate understanding of issues of backyard biodiversity, such as the need for habitats for animals.

Free software can be downloaded from: *Microsoft Photo Story 3* <http://www.microsoft.com/photostory>

Students and community can make their own digital story about the area they studied — some examples can be seen on the Queensland Museum website, available at: <www.qm.qld.gov.au/learningresources>

Ethics and animal trapping

Find information about trapping animals in *Animal Care and Protection Act 2001*, Chapters 1 to 8, available at: <http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/A/AnimalCaPrA01.pdf>

Biodiversity Assessments

What is biodiversity?

Biodiversity, or biological diversity, is the sum total of life forms on Earth, the genes they carry and the natural communities or ecosystems they form. (QM website)

What is the issue?

Biodiversity assessments should be conducted in the context of a local environmental impact issue. It could be:

- The effect of animal grazing on the bio-health of creek banks.
- The contribution to biodiversity of leaving small pockets of un-cleared vegetation in grazing land.
- The impact of human activities in forested or planted areas.
- Determination of biodiversity improvement as a result of rehabilitation activities.

Research question

A research question is generally a "*what is*" question about a significant issue. For example:

a) What is the effect of animal grazing on the riparian zone of the creek?

b) What is the impact of human activity (named) on the local forest area?

c) What is the impact of bike riding on the bio-health of the garden area near the school car park?

Background observations

Preliminary observations and assessment should be used to generate ideas for a firm hypothesis to research.

Assess the habitat

1. Abiotic conditions:

What abiotic conditions do we wish to measure? Measure a **range of conditions** using appropriate instruments:

- Temperature
- Humidity
- Moisture content of soil
- Light
- Wind

To measure a range of conditions a data logger is the preferred many conditions can be measured using readily available equipment.

Case study issue:

A rural primary school has a garden comprising of native shrubs and bushes near the school car park. The garden area appears to have been degraded by students riding their bikes through the garden slope after school hours. A plan to rehabilitate the area that takes account of all stakeholders needs to be made. To inform the decision making with scientific data, a biodiversity assessment of the area first needs to be conducted. This assessment should ascertain the current impact that the activities have on the biodiversity of the area.

2. Biotic data:

What biotic data can we collect?

- Plants including habitat description based on dominant plant type.
- Vertebrates (observation only)
  - Birds
  - Reptiles
  - Amphibians
  - Mammals
- Invertebrates (collection)
  - Spiders
  - Insects

Research hypothesis

A research hypothesis is generally a *cause-effect* statement that can be investigated by measuring an outcome. For example:

a) The grazing of animals on the creek banks reduces the biodiversity of the riparian zone.

b) The removal of fallen timber from the forest area reduces the biodiversity of the area.

c) The riding of bikes through the garden reduces the bio-health of the area.

Some terms such as "biodiversity" and "bio-health" will require further definition to establish *what* is to be measured.

Measuring bio-health

There are no "absolute" measures of bio-health of a habitat. However, indications of bio-health can be made through **comparative studies**:

One method is to compare the biodiversity of the area of interest (the study area) with an area of similar habitat considered to be relatively undisturbed. The assumption here is that the undisturbed area will provide biodiversity data indicating a healthy habitat. The data used for comparison can make use of known **bio-indicators**. For example:

- Populations of macro-invertebrates in riparian zones
- Populations of nymphs of macro-invertebrates in water indicate water quality
- Populations of decomposers in leaf litter
- Populations of ants can indicate disturbed areas.

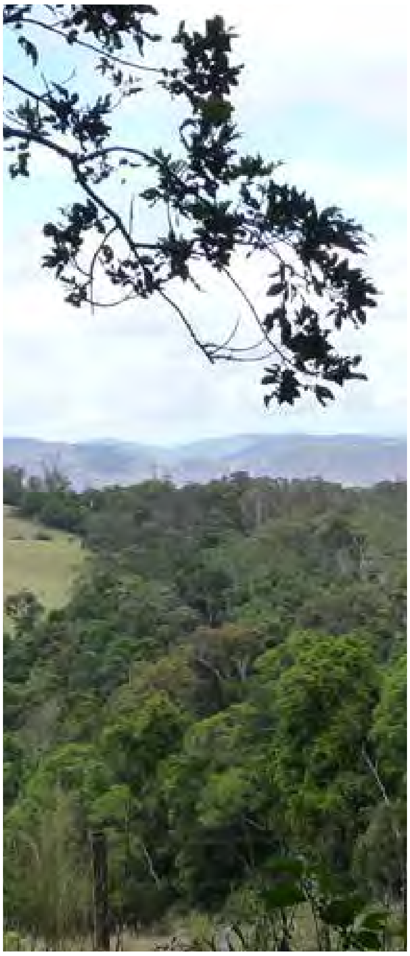
Other methods of determining biodiversity of habitats involve statistical analysis beyond the scope of this work.

Case study background observations:

Bike riding removes organic material, causes soil compaction as well as provides a water course that increases erosion. Preliminary observations indicate that while the bike tracks were clear of vegetation, the soil seemed neither overly compacted nor was there evidence of any severe surface erosion.

Case study hypothesis:

The riding of bikes through the native garden area reduces populations of ground beetles and bush cockroaches relative to populations of ants.



Research design

The real challenge at this level is to employ methods that will allow **fair comparisons** to be made between different areas. The basis for such methods should include:

1. Verifiable evidence
2. Repeatable methodologies

1. Verifiable evidence

In scientific studies, data must be verifiable. For data to be **verifiable** there must be **evidence** that can be viewed by people other than the collector of the data. Verifiable data must also include labeling information (covered later).

Evidence could be in the form of:

- Specimen with label
- Photographic image
- Video
- Sound recording
- Tracks either collected or photographed
- Scats, pellets
- Skeletons or other remains

Non-evidence examples:

- Catch and release methods that do not record verifiable evidence
- Observations by one person that are recorded as sightings
- Second hand reports of sightings

Case study research design:

- Identify a second area nearby that is relatively undisturbed by humans. In this case a native bush area across the road was chosen as the comparative area.
- Select different sites within the study area to compare parts affected by bike riding and parts where the bikes do not go. This provides two areas for study and different sites within the study areas with which to make comparisons.

Location 1: Native garden area

Site A: along a bike path
Site B: off bike path in heavy mulch

Location 2: Native bush area

Site C: edge of bush along path
Site D: inside bush area

Collection Methods

A variety of methods are used to **target** different types of invertebrates.

The methods are employed to intercept the invertebrates as they go about their daily activities. The methods also take advantage of the invertebrate's behavioural patterns. The idea is target those orders that will give the most useful data to answer the research question.

Collection methods should also be as **repeatable** as possible. In the case study areas this can be achieved by repeating the same collection methodologies at a similar time of year in the future. Recording abiotic conditions is critical for interpretation of data in longitudinal studies.

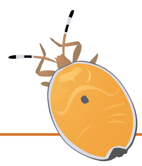
Case study data collection:

Targets:

- Cockroaches (Blattodea)
- Beetles (Coleoptera)
- Ants (Hymenoptera)

Method:

- Pitfall traps

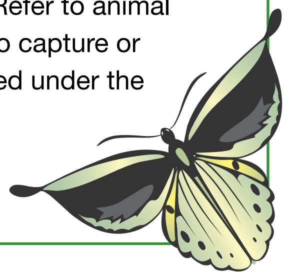


Method	Behavioural patterns	Orders
Netting	Flying up at disturbance	Lepidoptera; Odonata
Beating trays	Dropping at disturbance	Hemiptera; Arachnids; Hemiptera Phasmatodea
Pitfall traps	Ground dwellers	Blattodea; Hymenoptera (Ants); Coleoptera
Intercept traps	Flying down at obstruction	Coleoptera; Orthoptera; Hemiptera
Light sheets	Night flying	Lepidoptera (moths)
Pyrethrum knockdown	Bark dwellers	Blattodea; Coleoptera
Malaise traps	Flying up at obstruction	Diptera; Hymenoptera; (bees, wasps)

Animal Ethics

Collection methods would include identified methods of collecting verifiable data. Refer to animal ethics issues for appropriate collection methods. Essentially, permits are required to capture or handle vertebrates so collection is not recommended. Invertebrates can be collected under the *Animal Protection Act 2001*.

For scientific purposes and WHS issues the safe collection and preservation of invertebrates is considered appropriate practice.



2. Repeatable methodologies

Hand Netting

Standardise:

1. Net size and handle length
2. Netting duration
3. Team size

For example: A hand net with a 40cm diameter hoop and 2m long handle was used for a period of 15 minutes each by four people.

Beating tray

Standardise:

1. Size of tray
2. Number of beats
3. Number of trees beaten
4. Collection time

For example: 4 Sheets of A3 paper used to collect from each of 5 trees beaten 5 times each.

Pitfalls

Standardise:

1. Size of trap
2. Number of traps
3. Spacing of traps
4. Trapping duration.

Case study example:

5 pitfall traps of 2L ice cream containers were set in a north-south line with 2m between traps at each site. The traps were cleared after 2 days.

Malaise trap

Standardise:

1. Size of trap
2. Number of traps
3. Spacing of traps
4. Trapping duration.

For example: Identical malaise traps were set up on the same morning at each of the sites. The traps were cleared after 3 days.

Labels

The specimen once collected can only be verified if it has a **locality label**. Without a label the specimen has no scientific value.

Locality labels must include all of the details below and be placed inside the container **with the specimens**. Use a HB pencil on copy paper cut to size.

- location
- date
- collector's name
- habitat details
- collection method

Case study sample locality label:

- Qld: Bla, 10km SE Nambour, Bla SS, front garden
- 20 Jun 2010
- Year 6 Group1
- Melaleuca open forest
- Pitfall trap

Sorting and identification

The specimens are **identified to order** level then sorted into order groups and counted. Identification labels should be included with each group. Numbers of specimens can be added to the identification labels. **Locality labels** have to be **duplicated** and included with each group and in each container.

Identification to order is well within the capabilities of students and community members. The techniques required are very accessible and are covered in more detail later. It is neither necessary nor reasonable to classify to any further detail.

There are over 61 thousand species or different types of insects described for Australia. However only around a quarter are described. Therefore no-one can tell you the species for nearly 75% of the insects collected, as they have not yet been named.

Order level identification is all that is required of University students doing first year entomology. Family level identification requires further specialist training.

For some groups such as butterflies, dragonflies, stick insects, and praying mantids, there are field guides available that will allow many species to be identified.

See identification hints and CSIRO identification key to invertebrates.

Data collation

Data needs to be organised and presented so that interpretations can be made.

A **standardised format** for collating and presenting data provides an easier basis for comparative studies to be made.

You did collaborate with your comparative location to ensure that the data collection methodologies were comparable, didn't you?

Explore the data collation spreadsheet tool at the Wild Backyards microsite: http://www.qm.qld.gov.au/microsites/wild/index.html OR the Museum Magnet Schools: http://mms.eq.edu.au/html/ed-resources.html#Wild

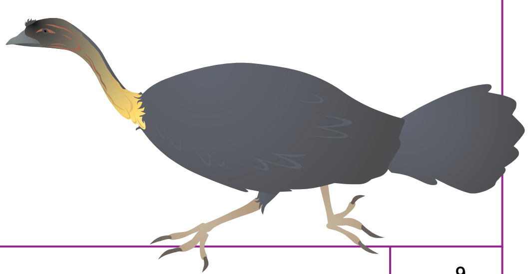
Data Collation Tool User Manual is available on the Museum Magnet Schools website at http://mms.eq.edu.au/html/ed-resources.html#Wild

Points to note:

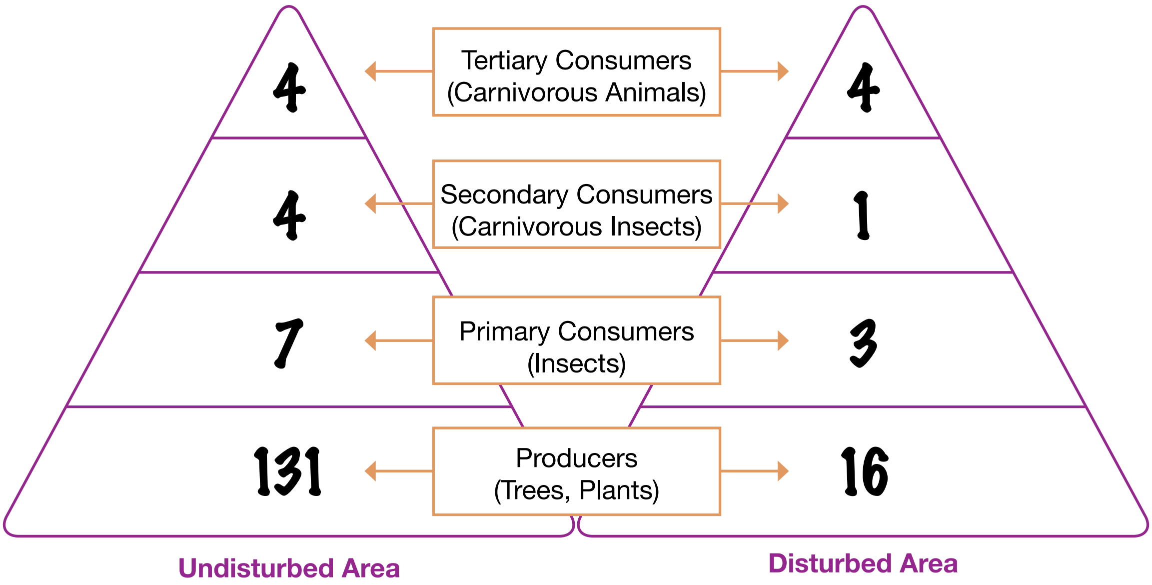
- School location and abiotic data is entered once for each site using forms.
- Each group has a separate sheet for recording data
- Drop-down menus used where possible
- Data values can be adjusted for site data
- Automatic collation of insect orders
- Graphs auto-generated
- Summary sheet presents all group data for one collection event at a single site.

Case study data collation:

- 4 data sheets required; one for each site at each location.
- Use the summary data for each data spreadsheet for analysis



Biodiversity



Analyzing the data

How healthy is the habitat?

Method 1:
Trophic level diagrams are used if a range of collection methods are used to target the full range of invertebrates likely to be found.

Based on examination of mouth parts and available food sources, organisms can be assigned a **trophic level**.

Consumer order or decomposer

A **pyramid of numbers** is constructed for each location using the summary data.

The trophic level diagrams above provide a basis for comparative analysis between the sites at the same location.

Method 2 **: (harder for students)
Examination of data detail can provide a basis for making judgments about bio-health.

Absence or presence of bio-indicators can be enough for experts to make judgments:

For example:

- Presence of crabs in mangroves is a positive indicator
- Presence of bush cockroaches in leaf littler is a positive indicator.
- Presence of large ant populations is an indicator of a disturbed habitat.

Looking at the macro-invertebrate decomposer populations is a way of assessing bio-health.

Case study analysis:

- Ground beetles (predators) and bush cockroaches (decomposers) of organic matter are found in leaf litter.
- Their population numbers are an indicator of bio-health.
- The assumption is made that the population number and distribution in the native bush area will be an indicator of a healthy habitat.

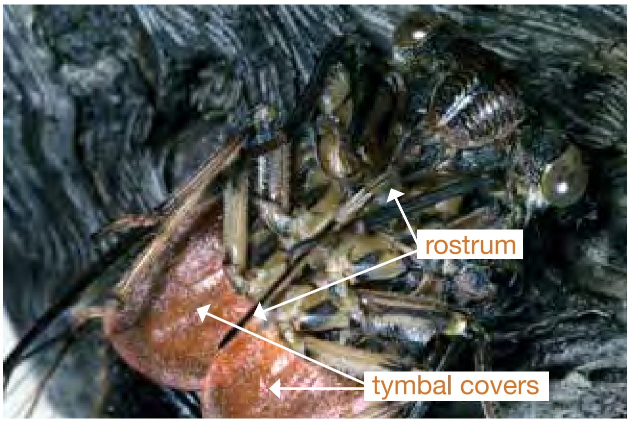
Hints for the use of keys

To identify Invertebrates such as insects, spiders and centipedes:

1. Do you have an adult? If you have a caterpillar or larva of an insect that undergoes abrupt or complete metamorphosis (eg butterfly, wasp, ant, beetles, flies) most keys will not work.

If you have a nymph of an insect that undergoes gradual or incomplete metamorphosis (eg grasshopper, true bug, and stick insect) some keys will work to at least order. Nymphs may be recognised by the wing buds, or developing wings present in later instars.

2. There is a group of insects called **bugs**. Not all insects are bugs. Therefore we call the members of the Order Hemiptera 'True bugs' including aphids, leafhoppers, cicadas. They are characterised by the sucking mouthparts, the rostrum, a strong straw like structure usually held between the front pair of legs.



3. Does your insect have **wings**? Can you see segments of the abdomen from above? If so, you may have an adult insect as many insects never have wings.

If not, there may be wings covering the abdomen. The forewings may be hardened to form elytra that meet in a straight line down the back. That's a beetle characteristic.

The hind wings are folded underneath and lifted out for flying.

The forewings may be leathery and have the hind wings folded beneath as in grasshoppers and crickets.

The base of the forewings may be leathery and the apex of the forewings and the hind wings membranous folded in a cross-like pattern as in some true bugs.

1. How many pairs of wings? Flies (and mosquitoes are flies) have only one pair of wings. The hind wings have been reduced to halters. They are little sticks with knobs on the end behind the forewings. Wasps and bees may appear to have only one pair of wings but the wings are hooked together, and they never have halters.

2. To see the mouthparts of an invertebrate you often need to look at the ventral side of the head, so turn them over.

3. What is the difference between butterflies and moths? Butterflies have clubbed antennae. The club may be at the apex, or just before the apex of the antenna. These are both butterflies.

4. Insects bite with their mouthparts. Assassin bugs and Giant water bugs are True bugs that can give a painful bite. These predators inject salivary juices into their prey that dissolve the flesh, and then suck the resultant soup up using their straw like mouthparts.

5. Bees, wasps, and ants belong to the Order Hymenoptera, referring to their window-like membranous wings. They can sting, using a modified ovipositor at the apex of the abdomen. Some people are allergic to these toxins. These insects should be avoided, and only handled when dead.

Pitfall traps

Catch ground-active invertebrates such as beetles, spiders and ants.

1. Each pitfall trap consists of two plastic ice-cream containers of the same size, with their lids. One lid has a large square hole cut in the middle, leaving about a 2 cm rim.

2. The cut-out lid is firmly attached to one ice-cream container, and it is placed inside the other.

The complete lid is added.

3. A hole is dug so that the combined ice-cream containers are fully within the ground.

Soil is firmly returned around the ice-cream containers so that the surface of the lid is flush with the soil surface.

4. The complete lid is removed carefully so that no soil falls into the ice-cream containers.

5. Soil is gently smoothed to fill the small trough in the rim of the cut-out lid.

6. Place a small piece of moistened sponge and a small piece of polystyrene into each container. The sponge will help reduce dehydration if any small vertebrates such as frogs and lizards fall into your traps. If it rains and the traps fill, the polystyrene acts as a raft for them to hang onto.

7. Cover each trap with a roof, open at two ends, and peg it down. You can use a polystyrene meat tray with the ends removed. This roof helps exclude rain, and may reduce the chance of vertebrates, such as frogs and reptiles, from falling into the traps.

8. Leave the trap overnight, but ensure you are able to check the trap at least every day to ensure no protected reptiles and frogs have been captured, and so they can be promptly released.

To take a sample:

9. Remove the roof.

Lift out the inner ice-cream container with the cut-out lid still firmly attached, carefully so that no soil falls into the sample.

10. Carefully remove the cut-out lid, so that no soil falls into the ice-cream container.

11. To retain your invertebrate sample for further study tip them into a container containing a preservative such as ethanol or methylated spirit.

12. Pour the preservative with the specimens into a container.

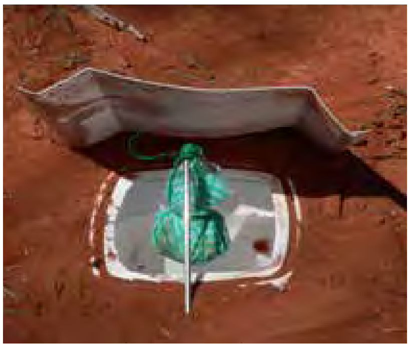
Add label. Tightly seal. You have a pitfall sample.

Baited pitfall traps

Dung-baited pitfall traps sample dung beetles and also act as short-term pitfall traps. The dung traps consist of the same container and lids used for the pitfall traps.

Water, with a small amount of detergent added, is poured into the container to a depth of approximately 2cm.

The bait consists of a ball of frozen dung (wallaby cow or human OR mushrooms), about 4cm in diameter, wrapped in kitchen wipe such as Chux.



The bait is suspended on the end of a twig, or peg, over the mouth of the container. As the bait thaws, the odour produced by the dung, attracts dung beetles which fall into the fluid. A roof can be pressed into the ground on one side, on an angle to prevent rain entering the trap. Traps should be installed in mid to late afternoon and emptied mid to late morning the following day, ensuring that diurnal, nocturnal and crepuscular dung beetles are sampled.

A wire mesh with openings of around 1cm may be laid over the pitfall, and pegged down, to exclude invertebrates. In this case the dung bait may be suspended beneath the wire mesh.

Glossary

Bio-indicator
Often called bio-indicator species. An animal or group of animals that are sensitive to changes in ecosystems e.g. certain frogs.

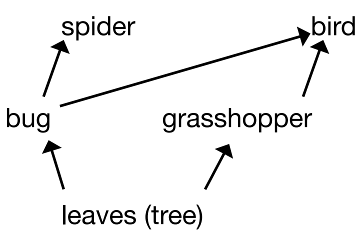
Carnivore
An animal that eats another animal e.g. spider.

Consumers
Living things that feed on other living things.

Ecosystems
Observing ecosystems is the main way the environment is studied. Ecosystems are groups of living things, the physical factors that affect their survival and any interactions, and can be as small as puddles.

Food chain
Diagram of relationships in an ecosystem as a single pathway e.g. leaves (tree) → bug → spider.

Food web
Diagram of feeding relationships in an ecosystem as interconnecting food chains. Shows animals often have many food sources, e.g.



Habitat
Place of a living thing. Contains all an organism's requirements and factors that affect survival e.g. insects live in schoolyard habitats.

Herbivore
An animal that eat plants e.g. grasshopper.

Humus
Pieces of decayed animal and plant matter in the soil that affect the soil's physical factors including water-holding capacity, nutrients and pH.

Microhabitat
A specific part of a habitat e.g. leaves of a tree.

Mouthparts
Parts that make up the mouths of insects e.g. special feeding appendages (jaws) for chewing in grasshoppers; coils for sucking in butterflies. Chewing mouthparts are sometimes used to make nests e.g. termites.

Niche
Role of an organism in an ecosystem e.g. seed-eating ground-living parrot.

Producers
Plants are producers, not consumers. They make food in a chemical reaction called photosynthesis, which uses the energy of the sun, and carbon dioxide and water.

Pyramid of numbers
A graph of the numbers of living things in a food chain or web. It resembles a pyramid because the numbers of living things decrease at high trophic levels.

Omnivore
An animal that eats plants and animals e.g. Honeyeater.

Order
Classification group widely-used in insect identification e.g. Lepidoptera (butterflies and moths), Coleoptera (beetles).

pH
A scale from 1–14, measured using universal indicator. Acids have a low pH (1–6). Bases have a high pH (8–14). Water is neutral, pH 7.

Physical factor
A non-living factor that affects the survival of living things e.g. temperature. Able to be measured.

Quadrat
A plastic or wire square, area from 100 cm^2–10 m^2. Size used depends on the size of the habitat to be sampled e.g. 100 cm^2 to count crab holes.

Transect
A rope line marked every 5 or 10 m. Used to sample an ecosystem e.g. for the number and type of plants.

Trophic levels
Feeding levels in an ecosystem e.g. plants are level 1, herbivores are level 2. Used to construct pyramid of numbers, and biomass and energy pyramids.

Backyard Explorer for the Early Years

Essential Learnings by the end of Year 3

SCIENCE

Ways of working

- All elements addressed

Knowledge and understanding

Science as a human endeavour

Science is a part of everyday activities and experiences.

• Science has applications in daily life, including at home, at school, at work and in leisure time e.g. *Pest control methods can be ecologically friendly*.

• Science can impact on people and their environments e.g. *knowledge of the effects of humans influences how to care for the environment*.

• Stewardship of the environment involves conserving natural resources e.g. *strategies to conserve water and preserve wilderness environments*.

• Australian Indigenous knowledge of natural phenomena has developed over time as a result of people observing, investigating and testing in everyday life e.g. *observing changes in the environment to help determine seasons*.

Earth and beyond

Changes in the observable environment influence life.

• Earth and space experience recurring patterns and natural cycles of events, including seasons, weather and moon phases, and these can affect living things e.g. *tides affect life on the shoreline; seasons affect the growth of plants; some animals hibernate in winter*.

Life and living

Needs, features and functions of living things are related and change over time.

• Animals, plants and non-living things have different features/characteristics e.g. *some animals have wings; unlike plants and animals, rocks do not grow*.

• Change occurs during the life cycle of living things e.g. *Some young animals look like the adult but others do not*.

• Living things depend on the environment and each other e.g. *plants need light to make food; some insects pollinate flowers*.

Whilst the student activity sheets are generally unsuitable for the younger students, the key concepts of the Essential Learnings for Life and Living can easily be addressed through related activities in the school yard.

KEY IDEAS:

- Humans have an impact on the environment
- There are differences among animals
- Living things can have different life cycles.
- There are different roles that animals play in the environment

SUGGESTED ACTIVITIES:

- Explore school yard with a local indigenous person or expert.
- Collect and identify beetles, bush cockroaches and ants in pitfall traps
- Compare different populations of beetles, bush cockroaches and ants at different locations through pitfall traps. Relate to human impact.
- Obtain a pair of bush cockroaches to maintain in a classroom micro-habitat to observe feeding behaviour and life cycles.
- Collect pupa and larvae and keep until hatched to determine life cycles.

Backyard Explorer for the Middle Years

Curriculum links

Essential Learnings by the end of Year 9

SCIENCE

Ways of working

- All elements

Life and living

Organisms interact with their environment in order to survive and reproduce.

• In ecosystems, organisms interact with each other and their surroundings *e.g. the scavenger role of the crab in the mangroves means that it has a plentiful supply of food and it contributes by cleaning its surroundings*

• Changes in ecosystems have causes and consequences that may be predicted *e.g. bushfires destroy natural bushland, which temporarily changes the ecosystem; birds return to dried-up waterholes after rain*

Science as a human endeavour

Responsible and informed decisions about real-world issues are influenced by the application of scientific knowledge.

• Immediate and long-term consequences of human activity can be predicted by considering past and present events

• Responsible, ethical and informed decisions about social priorities often require the application of scientific understanding

TECHNOLOGY

ICT

Operating ICTs

Students use a range of advanced ICT functions and applications across key learning areas to inquire, create, collaborate and communicate, and to efficiently manage information and data. They:

• apply efficient operational sequences for the operation of a variety of ICTs

• apply formats and conventions when undertaking tasks

• describe a range of devices and processes for performing complex tasks using the correct ICT specific terminology

• apply agreed processes for accessing and working with personal information and content access appropriate support when updating or learning new operational skills

• manage integrity of information and content in personal or collaborative digital environments

• reflect on, analyse and evaluate their operational skills to meet the requirements system resources, processes and conventions in personal or collaborative digital environments.

Creating with ICTs

Students experiment with, select and use ICTs to create a range of responses to suit the purpose and audience. They use ICTs to develop understanding, demonstrate creativity, thinking, learning, collaboration and communication across key learning areas. They:

• express and creatively represent ideas, information and thinking in innovative ways.

Communicating with ICTs

Students experiment with, select and use ICTs across key learning areas to collaborate and enhance communication in local and global contexts for an identified purpose and audience. They:

• collaborate, exchange ideas, distribute information, present critical opinions, problem solve and interpret messages

• consider and apply ICTs to enhance interpersonal relationships in order to develop social and cultural understandings

• apply suitable presentation and communication conventions and protocols

• select and apply a variety of ICTs to exchange and interpret messages and meanings

• present an individual or group identity in communication

• reflect on feedback to analyse and improve their use of ICTs and to describe more effective use of ICTs in future communications.

Essential Learnings by the end of Year 7

SCIENCE

Ways of working

- All elements

Knowledge and understanding

Science as a human endeavour

Science impacts on people, their environment and their communities.

• Scientific knowledge has been accumulated and refined over time, and can be used to change the way people live *e.g. Research on biodiversity informs us about ways to live sustainably.*

• Ethical considerations are involved in decisions made about applications of science *e.g. preservation of wilderness environments to help protect endangered species.*

• Scientific knowledge can help to make natural, social and built environments sustainable, at a scale ranging from local to global *e.g. Increasing biodiversity improves the bio-health of the environment.*

Life and living

Living things have structures that enable them to survive and reproduce.

• Systems of scientific classification can be applied to living things *e.g. dichotomous keys can be designed for groups of organisms*.

• Survival of organisms is dependent on their adaptation to their environment *e.g. animals use camouflage to protect themselves; animal mouth parts are adapted for their food sources; animals have specific structures and behaviour for their defence mechanisms*

• Different feeding relationships exist within an ecosystem *e.g. producer, consumer, herbivore, carnivore populations form trophic level relationships that can be used to assess bio-health*.

TECHNOLOGY

ICT

Creating with ICTs

Students use ICTs to develop understanding, demonstrate creativity, thinking, learning, collaboration and communication across key learning areas. They:

• express and creatively represent ideas, information and thinking

• reflect on their use of ICTs as creative tools and evaluate the quality of their ICT responses, plans and processes against criteria.

Communicating with ICTs

Students experiment with, select and use ICTs across key learning areas to collaborate and enhance communication with individuals, groups or wider audiences in local and global contexts for an identified purpose and audience. They:

• collaborate, develop, organise and present new ideas • consider how ICTs can be used to enhance interpersonal relationships and empathise with people in different social and cultural contexts

• apply suitable or agreed communication conventions and protocols

• select and apply a variety of digital media to improve communication

• establish their own or a group image and identity in communication

• reflect on their use of ICTs and consider feedback to improve collaboration and refine and communicate meaning.

Operating ICTs

Students use a range of advanced ICT functions and applications across key learning areas to inquire, create, collaborate and communicate, and to manage information and data. They:

• apply operational conventions when using ICTs

• identify operational advantages to manage personal ICT resources and customise interfaces

• apply agreed processes for personal management of digital content and identify the advantages of customisation.

Essential Learnings by the end of Year 5

SCIENCE

Ways of working

• All elements

Knowledge and understanding

Science as a human endeavour

Science relates to students' own experiences and activities in the community.

• Ethics is a significant part of scientific endeavour *e.g. an ethical consideration is whether or not it is appropriate to collect animals for scientific purposes*.

• Science can help to make natural, social and built environments sustainable and may influence personal human activities *e.g. implementing "green" strategies may help to minimise a person's "ecological footprint"*.

Earth and beyond

Changes and patterns in different environments and space have scientific explanations.

• Changes to the surface of the earth or the atmosphere have identifiable causes, including human and natural activity *e.g. human impacts such as removal of habitats affect the biodiversity of an area; humans can improve biodiversity by rehabilitating habitats*.

Life and living

Living things have features that determine their interactions with the environment.

• Living things can be grouped according to their observable characteristics *e.g. insects have six legs; marsupials have pouches; fish have gills and fins*.

• Structures of living things have particular functions *e.g. mouth parts are adapted for particular food sources*;

• Reproductive processes and life cycles vary in different types of living things *e.g. insects develop through complete or incomplete metamorphosis*

• Living things have relationships with other living things and their environment *e.g. the relationship between a bee and a flowering plant is mutually beneficial*.

Sample assessment instruments

Years 8/9 Science Ecology Study Student: ______________________

Data collection, analysis and reporting of ecology study: Assessable elements	Descriptors				
	A	B	C	D	E
Knowledge and understanding	Comments about or names the habitat using data. Identifies 11–20 common insects from different microhabitats (leaves, leaf litter, ground) using the dichotomous key. Records detailed habitat, mouthparts and diet data about insects, reptiles and birds, and classifies them according to niche. Collects detailed data about physical factors. Makes a good assessment of biodiversity using data.	Comments about or names the habitat using data. Identifies 10 or so common insects from different microhabitats (leaves, leaf litter, ground) using the dichotomous key. Records detailed habitat, mouthparts and diet data about insects and birds. Collects detailed data about physical factors. Makes an assessment of biodiversity using data.	Comments about or names the habitat. Identifies at 5–10 common insects from different microhabitats using the dichotomous key, their mouthparts and diet from a range of microhabitats (leaves, leaf litter, ground), as well as birds or reptiles. Classifies them according to the food they eat. Collects some data about physical factors. Makes an assessment of biodiversity.	Identifies the habitat, some common insects and their mouthparts and diet. Classifies some of these according to the food they eat	Rudimentary knowledge and understanding of insect identification, habitat and diet.
Investigating	Data collection is detailed, with logical, complete and well-labelled tables, quality sketch of vegetation profiles. Investigates own problem using data at own or other site.	Data collection is detailed, with logical, complete and well-labelled tables, good sketch of vegetation profiles.	Data collection mostly complete. Data tables lack some detail in insects identified, physical factors or labelling. Vegetation profile attempted.	Some parts of data collection not done. Some parts of the data tables not complete.	Many parts of data collection not done. Tables quite incomplete.
Evaluates data, identifies connections and links results to theory	Analysis and evaluation shows a detailed understanding of ecological issues: habitat change due to human causes, insect and bird niches and lifecycle stages, numbers pyramid. Compares one site with another in some detail. Draws well-reasoned conclusions which show interrelatedness of many factors measured.	Analysis and evaluation shows understanding of ecological issues: habitat change due to human causes, insect and bird niches and lifecycle stages, numbers pyramid. Compares one site with another. Draws reasoned conclusions using some of the factors measured.	Relevant analysis and evaluation including some of habitat change due to human causes, insect and bird niches and lifecycle stages, numbers pyramid, to draw credible conclusions. Simple comparison with other sites.	Narrow analysis and evaluation to propose obvious conclusions.	Cursory analysis and evaluation to propose conclusions.
Communicates scientific ideas using scientific terminology appropriately	Uses a range of terms skillfully in report or digital story.	Uses a range of terms in report or digital story and in conclusions. Some used well.	Uses some terms in digital story and in conclusions. Some used well.	Occasionally uses terms in digital story and in conclusions.	Rarely uses terms in digital story or in conclusions.
Guide to making judgements			Overall: A B C D E		

ICTS

Creating with ICTs

- Create and document and present their learning, thinking and learning, using photos and the media of digital stories

Communicating with ICTs

- Identify group in forum or database
- Use the forum to post, and critically analyse and problem solve questions or comment on results of others to develop links with other schools
- Apply the conventions and protocols of the digital story genre
- Create a biodiversity message in the digital story
- Reflect and improve on the way they take photos or make digital stories

Operating ICTs

Use an interactive database to record results, save data and access data records of other groups

Year 7 Science Ecology Study   Student: ____________________

Data collection, analysis and reporting of ecology study: Assessable elements	Descriptors				
	A	B	C	D	E
Knowledge and understanding	Identifies the habitat, 5 common insects, their mouthparts and diet from a range of microhabitats (leaves, leaf litter, ground), as well as birds and reptiles, and does this in some detail. Classifies these according to the food they eat. Identifies one or two other insects accurately using the dichotomous key. Names them appropriately. Makes a good assessment of biodiversity using data.	Identifies the habitat, 5 common insects, their mouthparts and diet from a range of microhabitats (leaves, leaf litter, ground), as well as birds and reptiles, and does this is some detail. Classifies these according to the food they eat. Identifies one other insect using the dichotomous key. Names them appropriately. Makes an assessment of biodiversity using data.	Identifies the habitat, at least 5 common insects, their mouthparts and diet from a range of microhabitats (leaves, leaf litter, ground), as well as birds or reptiles. Classifies these according to the food they eat. Uses the dichotomous key. Makes an assessment of biodiversity.	Identifies the habitat, some common insects, their mouthparts and diet. Classifies some of these according to the food they eat.	Rudimentary knowledge and understanding of insect identification, habitat and diet.
Investigating	Data collection is detailed, with logical, complete and well-labelled tables, quality sketch of vegetation profiles. Investigates own problem using data collection methods and shows this data.	Data collection is detailed, with logical, complete and well-labelled tables, good sketch of vegetation profiles.	Data collection mostly complete. Data tables lack some detail in specimens trapped and identified or labels. Vegetation profile attempted.	Some parts of data collection not done. Some parts of the data tables not complete.	Many parts of data collection not done. Tables quite incomplete.
Evaluates data, identifies connections and links results to theory	Discerning analysis and evaluation to draw well-reasoned conclusions.	Logical analysis and evaluation to draw reasoned conclusions.	Relevant analysis and evaluation to draw credible conclusions.	Narrow analysis and evaluation to propose obvious conclusions.	Cursory analysis and evaluation to propose conclusions.
Communicates scientific ideas using scientific terminology appropriately	Uses a range of terms skillfully in digital story and in conclusions.	Uses a range of terms in digital story and in conclusions. Some used well.	Uses some terms in digital story and in conclusions. Some used well	Occasionally uses terms in digital story and in conclusions.	Rarely uses terms in digital story or in conclusions.
Guide to making judgements			Overall: A B C D E		

Year 7 Technology (ICT) Digital Story Production

Student: ______________________

Photostory production: Assessable elements	Descriptors				
	A	B	C	D	E
Knowledge and understanding	Uses 8-16 slides to make digital story 11/2 -2 minutes in length. Uses digital story devices including transitions, text, and layout.	Uses 8-16 slides to make digital story 11/2 -2 minutes in length. Uses digital story devices including transitions, text, and layout.	Uses 8-16 slides to make digital story 11/2 -2 minutes in length. Use digital story devices including transitions, text, and layout.	Uses 8-16 slides to make a digital story. Variable use of digital story devices.	Rudimentary knowledge and understanding of digital story devices.
Investigating and designing	Uses scientific research very well to choose and interpret digital story content. Shows this content in photos, storyboard and script of the digital story. Script complements photos.	Uses scientific research well to choose and interpret digital story content. Shows this in photos, storyboard and script of the digital story.	Uses scientific research satisfactorily to choose and interpret digital story content. Shows this in photos, storyboard and script of the digital story.	Variable interpretation and analysis of scientific research to choose and interpret digital story content.	Rudimentary interpretation and analysis of scientific research to choose and interpret digital story content.
Producing	Quality photos showing composition and good lighting. Implementation of production processes such as transitions, motion, text and text slides as well as voice-overs make a coherent digital story.	Some quality photos. Implementation of production processes such as transitions, motion, text and text slides as well as voice-overs to make a digital story.	Implementation of production processes such as transitions, motion, text and text slides as well as voice-overs to make a digital story.	Variable implementation of production processes such as transitions, motion, text and text slides as well as voice-overs to make a digital story.	Minimal implementation of production processes to make a digital story.
Evaluating	Insightful self-critique of digital story and processes based on audience response.	Informed self-critique of digital story and processes.	Relevant self-critique of digital story and processes.	Narrow evaluation of digital story and processes.	Cursory evaluation of digital story and processes.
Reflecting	Perceptive reflection on the use of a digital story to present a biodiversity message.	Informed reflection on the use of a digital story to present a biodiversity message.	Relevant reflection on the use of a digital story to present a biodiversity message.	Superficial reflection on the use of a digital story to present a biodiversity message.	Cursory reflection on the use of a digital story to present a biodiversity.
Guide to making judgements			Overall: A B C D E		

Backyard Explorer for Senior Biology

Research Issues

Contexts for developing research questions include:

1. Assessing human impacts on biodiversity and bio-health
2. Determining bio-indicators of environmental factors
3. Determining causative factors for differences in biodiversity between study areas

Research Methodologies

1. Comparative studies must be used
2. Collection techniques must be replicable between sites
3. Abiotic data critical for comparative studies

Extended Response Task: Year 11

Collect, analyse and report on fieldwork data.

- Group collection, individual analysis and report writing.
- One week, in class and own time.

Extended Experimental Investigation: Year 12

Ecological field study: student-designed

- Collection of raw data and 5 weeks subsequent analysis of an aspect of the data.
- Presented as a recommendation to a nominated audience.

Queensland Studies Authority

Senior Biology 2004 (amended) p5

4.3 Evaluating biological issues (EBI)

This objective aims to develop in students the ability to embrace current biological understandings and ideas to evaluate the effects of their application on present-day and future society.

Students will be required to gather information, predict outcomes, and make and communicate informed decisions about the effects of human intervention on biological systems

Backyard Explorer for Community Groups

Research Issues

Local area contexts include:

1. Creating biodiversity inventories of habitats
2. Assessing human impacts on biodiversity and bio-health
3. Monitoring bio-indicators of environmental factors
4. Determining possible causative factors for differences in biodiversity between study areas
5. Comparing temporal changes in biodiversity of habitats

Methodologies

Key features include:

1. Comparative studies
2. Replication of collection techniques

Results

Useful for:

1. Preliminary investigation of environmental issues
2. Informing community about biodiversity
3. Raising awareness of the extent of biodiversity in local area
4. Providing directions for further study

Limitations include:

1. Identification only to order limits scientific reporting
2. Data only forms a guide for future scientific study
3. Errors can occur due to non-comparative methods and misidentifications

Resources

Australian Entomological Supplies Available at: http://www.entosupplies.com.au/ (Accessed 14 July 2010)

Brisbane City Council (2005) *Terrestrial Invertebrate Status Review: Brisbane City*. Queensland Museum: Brisbane. Available at: http://www.qm.qld.gov.au/Learning+Resources/Resources (Accessed 6 July 2010)

Curtis, S. (2006) *Wild Things in the School Grounds*. Workshop. Brisbane: Queensland Museum.

Department of the Environment and Water Resources (2007) *About Australia's Native Vegetation*. Canberra: Commonwealth of Australia. Available at: http://www.environment.gov.au/land/vegetation/index.html (Accessed 6 July 2010).

Garden, J.G. et al. (2006) Review of the ecology of Australian urban fauna: A focus on spatially explicit processes. *Austral Ecology*, 31, p126–148

Garden, J.G. et al. (2007) Habitat structure is more important than vegetation composition for local-level management of native terrestrial reptile and small mammal species living in urban remnants: A case study from Brisbane, Australia. *Austral Ecology*, 32, p669–685

Insect specimens from Australian Insect Farm. Available at: http://www.insectfarm.com.au/

and Mt Glorious Butterflies http://www.mountgloriousbutterflies.com/ (Accessed 14 July 2010).

Jones, D. (2002) *Magpie Alert: Learning to Live with a Wild Neighbour*. Sydney: NSW Press

Malaise Traps from Sante Traps Available at: http://www.santetraps.com/ (Accessed 14 July 2010).

Queensland Museum (2007) Science *Skills: How to name habitats*. Available at: http://www.qm.qld.gov.au/Learning+Resources/Resources (Accessed 6 July 2010)

Queensland Museum (2007) *Science Skills: How to sample mangrove habitats*. Available at: http://www.qm.qld.gov.au/Learning+Resources/Resources (Accessed 6 July 2010)

Queensland Museum (2007) *Wildlife of Greater Brisbane: A Queensland Museum Wild Guide*. Brisbane: Queensland Museum.

Queensland Museum Guides:

- Ants of Brisbane
- Backyard Insects of Brisbane
- Birds of Brisbane
- Freshwater Fishes of the Greater Brisbane Region
- Frogs of South east Queensland
- Raptors of Southern Queensland
- Snakes of South East Queensland
- Spiders of the Greater Brisbane Region
- Wild Plants of Greater Brisbane
- Wildlife of Tropical North Queensland

Available at: http://www.qm.qld.gov.au/shop

Queensland Museum Learning Resources:
Wild Backyards Available at: http://www.qm.qld.gov.au/microsites/wild/index.html

Museum Magnet Schools:
Backyard Explorer Available at: http://mms.eq.edu.au/html/ed-resources.html

Queensland Museum NEW WEBSITE

All about Queensland Animals
Available at: http://www.qm.qld.gov.au/Find+out+about/Animals+of+Queensland

Wild Backyards Virtual Field Trip
The Education Queensland Learning Place field trip room allows communities from regional, remote and metropolitan Queensland to compare data about the insects they trap and collect.

A **data collation tool** is also available for download from the site. http://www.learningplace.com.au/vftprojects/57/

Identification of Australian Adult Insects:

CSIRO Key to Invertebrates Available at: http://www.ento.csiro.au/education/key/couplet_01.html

For keys to Families of Australian Insects visit **TRIN/CSIRO What Bug is That**? Available at: http://anic.ento.csiro.au/insectfamilies/

Equipment list

- Transect lines
- Tent pegs
- 1 m^2 quadrats
- Gloves
- Physical factors
- Thermometers
- Water
- Distilled water

****For the soil pH test, or use a commercial kit**

- Universal indicator solution
- Barium sulfate powder
- Hydrogen peroxide solution
- Tiles, spotting tiles
- Stirring rod or skewer
- Test tubes
- Gloves
- Anemometer (to measure wind speed)
- Hygrometer (to measure relative humidity)

Invertebrate study

- Broom handles or pieces of dowel of similar length
- Beating trays or calico sheets
- Butterfly or sweep nets
- White tote boxes
- Rakes
- Ice cream containers (1 or 2 L)
- Perspex roofing or chicken wire
- Trowels
- Specimen jars
- Labels
- Methylated spirit (optional)
- Washing up detergent
- Rubber gloves
- Hand wash

Bird watch

- Binoculars (optional)
- Field guide